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## WHAT IS CLAIMED IS:

1. A semiconductor structure comprising: a substrate and a  $Sn_xGe_{1-x}$  layer formed over the substrate, wherein x has a value from about 0.02 to about 0.20.

- 2. The semiconductor structure of claim 1 wherein the  $Sn_xGe_{1-x}$  layer is an epitaxial layer with a direct band gap between about 0.72eV and about .041eV.
- 3. The semiconductor structure of claim 1, wherein x has a value of about 0.20 and the  $Sn_xGe_{1-x}$  layer is a direct-gap material.
- 4. The semiconductor structure of claim 1, wherein the substrate comprises a silicon substrate.
- 5. The semiconductor structure of claim 4 wherein the substrate comprises Si(100).
- 6. The semiconductor structure of claim 4 wherein the substrate comprises Si(111).
- 7. The semiconductor structure of claim 1, wherein the substrate comprises a silicon substrate and the  $Sn_{1-x}Ge_x$  layer is formed directly on the substrate.
- 8. The semiconductor structure of claim 7 wherein the substrate comprises Si(100).
- 9. The semiconductor structure of claim 7 wherein the substrate comprises Si(111).
- 10. The semiconductor structure of claim 1 wherein the  $Sn_xGe_{1-x}$  layer has a thickness from about 50nm to about 1000nm.
- 11. The semiconductor structure of claim 1 further comprising a strained Ge layer formed over the  $Sn_xGe_{1-x}$  layer.
- 12. The semiconductor structure of claim 11 wherein x is greater than about 0.11 and the strained Ge layer is a direct-gap material.
- 13. A semiconductor structure comprising: a Ge-Sn quantum structure formed over a silicon substrate.

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14. The semiconductor structure of claim 13 wherein the Ge-Sn quantum structure comprises  $Ge_{1-x}Sn_x$  and x has a value from about 0.02 to about 0.03.

- 15. The semiconductor structure of claim 13 wherein the Ge-Sn quantum structure is formed over Ge-Sn epitaxial layer formed over the silicon substrate.
- 16. The semiconductor structure of claim 13 wherein the substrate comprises Si(100).
- 17. A method for depositing an epitaxial Ge-Sn layer on a substrate in a chemical vapor deposition reaction chamber, the method comprising introducing into the chamber a gaseous precursor comprising SnD<sub>4</sub> under conditions whereby the epitaxial Ge-Sn layer is formed on the substrate.
- 18. The method of claim 17 wherein the gaseous precursor comprises  $SnD_4$  and high purity  $H_2$ .
- 19. The method of claim 17 wherein the gaseous precursor comprises high purity  $H_2$  of about 15-20% by volume.
- 2O. The method of claim 17 wherein the gaseous precursor is introduced at a temperature in a range of about 250°C to about 350°C.
- 21. The method of claim 17 wherein the substrate comprises silicon.
- 22. The method of claim 21 wherein the silicon comprises Si(100).
- 23. The method of claim 17 wherein the Ge-Sn layer comprises  $Sn_xGe_{1-x}$  and x is in a range from about .02 to about .20.
- A method for depositing a strained Ge layer on a silicon substrate with a Ge-Sn buffer layer in a chemical vapor deposition reaction chamber, the method comprising introducing into the chamber a combination comprising SnD<sub>4</sub> and Ge<sub>2</sub>H<sub>6</sub> under conditions whereby the Ge-Sn layer is formed on the substrate and dehydrogenating Ge<sub>2</sub>H<sub>6</sub> under conditions whereby the Ge layer is formed on the Ge-Sn buffer layer.